MAE 578, Spring 2019, HW5 solution

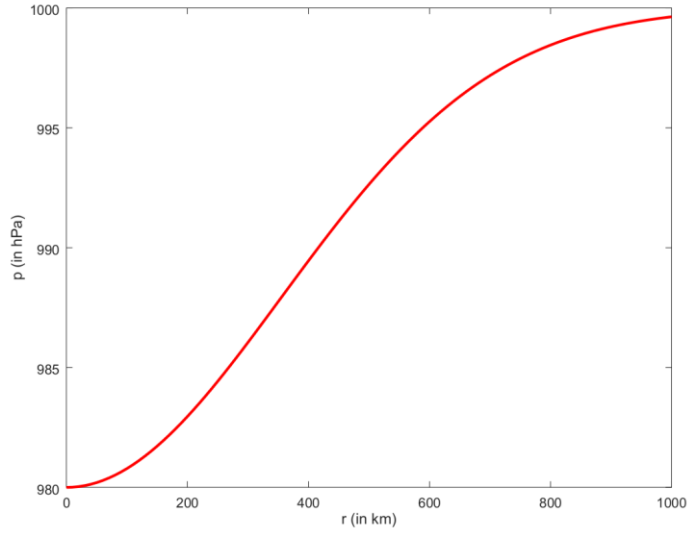
Prob 1

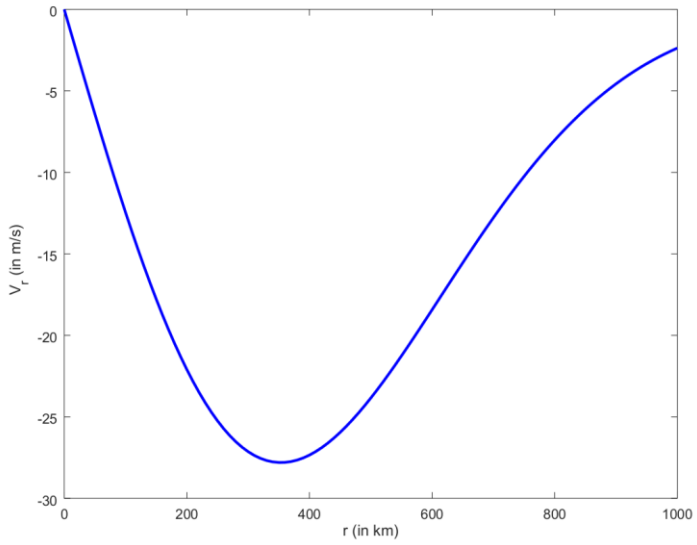
The flow is axially symmetric with the tangential velocity

$$V_r = \left(\frac{2\Delta p}{f\rho R^2}\right) r \exp[-(r/R)^2],$$

where $f = 2\Omega \sin(-45°)$ and $\Omega = 2\pi/(86400\text{ s})$. Since $f < 0$, we have $V_r < 0$. The circulation is clockwise around the low-pressure center. The maximum wind speed occurs at $r = R/\sqrt{2} = 353.5$ km. At that radius, the magnitude of velocity is 27.8 m/s if the density of air is given as 1.2 kg/m$^3$ (typical value at lower troposphere).

Plots:



Prob 2

$\Delta Z$ = 1412 m,  $u$ = 40.4 m/s

Prob 3

The $u$-velocity at the 1-mb level is 127.9 m/s.

Prob 4

The depth of the river at the eastern boundary exceeds that at the western boundary by 0.52 mm.